

Thin Target effusion calculations using GEANT4

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Introduction

- The simulation is performed using the **GEANT4** toolkit (NIM A 506(2003),250-303).
- The isotopes of different mass (A) are simulated by alpha particles with the proper thermal energy.

$$E_{th} = 3/2(8.615 \cdot 10^{-5}) T \ 4/A$$

- The temperature is $T = 2273 \text{ K}$.

Geometry

Container : Cylindrical tube (1 mm thick): radius 4 cm; length 24 cm

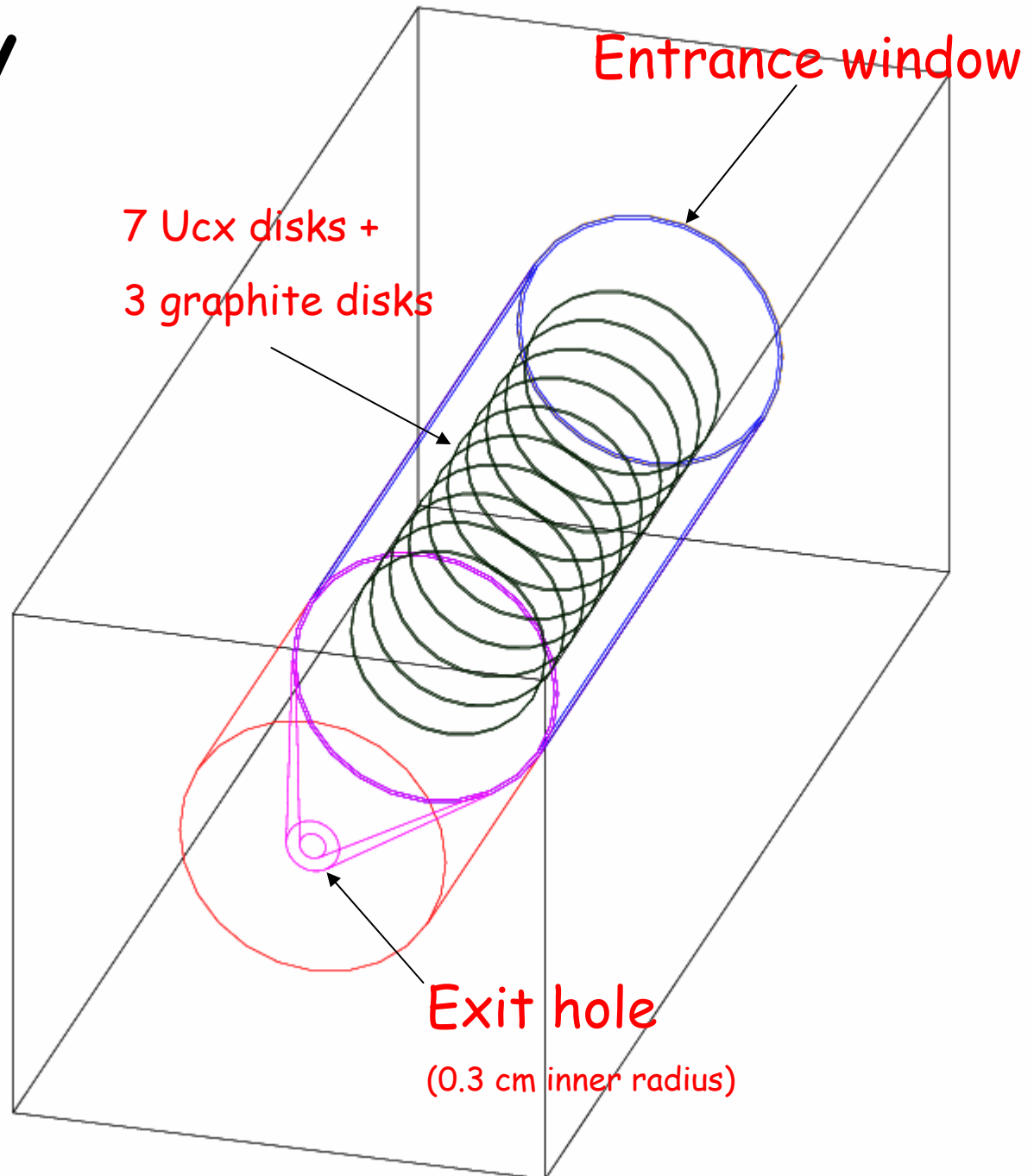
UCx Disks: radius 3 cm; 1 mm thick. Mass ~9 g; ($\rho = 2.5 \text{ g/cm}^3$)

Graphite Disks: radius 3 cm; 0.2 mm thick. ($\rho = 1.75 \text{ g/cm}^3$)

Graphite window: radius 4 cm, 0.4 mm thick.

Spacing Between disks: 2 cm

Exit cone length: 12 cm



Example

➤ The events originate with the thermal velocity in a random position in the region of the UCx disks.

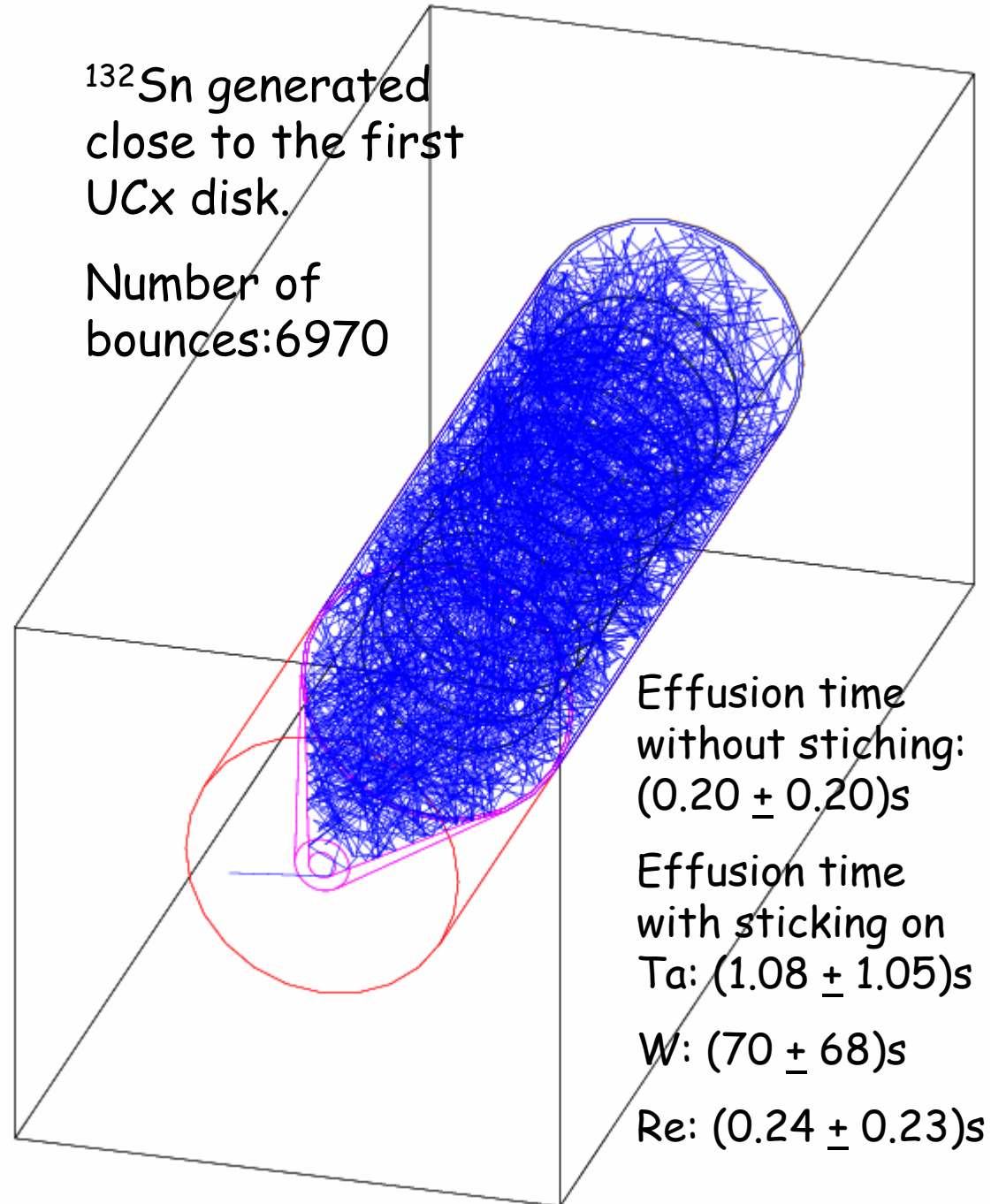
➤ Isotopes considered: ^{132}Sn , ^{90}Kr , ^{81}Ga .

➤ When an ion strikes the walls of the container or the disks it is emitted in a random direction after the "sticking time"

➤ Several times the nuclei bounce on the disk surfaces. In a first approximation we assume for the disks the same sticking time of the walls.

^{132}Sn generated close to the first UCx disk.

Number of bounces: 6970



Preliminary results

- 1000 events
- Average number of bounces: 5770

Ion ($T_{1/2}$)	Effusion time without sticking
^{132}Sn ($t_{1/2} = 39.7$ s)	$(0.25 \pm 0.25)\text{s}$
^{90}Kr ($t_{1/2} = 32.3$ s)	$(0.21 \pm 0.21)\text{s}$
^{81}Ga ($t_{1/2} = 1.2$ s)	$(0.20 \pm 0.20)\text{s}$

No sticking time data are available for the considered ions in Graphite or UC_2

Conclusions

- GEANT4 allows to define complex geometries and to simulate the effusion process.
- The preliminary results indicate that the calculated effusion time for the considered ions is significantly lower than their half-life. This value is a lower limit to the real effusion time since the sticking time on UC_2 and graphite was neglected.
- Sticking times on UC_2 and graphite should be measured and used for a more accurate calculation.
- The present geometry can be modified to optimize the design of the target.